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NONFLAMMABLE LIQUIDS FOR CRYOSTATS

Several very serious accidents in laboratories have resulted from the use of flammable liquids, such as volatile petroleum distillates, or toluene, to form the bath of a cryostat. In some instances explosions have occurred and burning liquid has been thrown upon the operator.

The purpose of this investigation has been to find liquids that will not burn, that have very low freezing points, and that are otherwise suitable for use as cryostat liquids. The materials tried were halogen derivatives of methane, ethane, and ethylene, and mixtures of these substances containing from two to five components. The freezing points, and in some cases the viscosities of such liquids, were determined. Attention has also been given to their corrosiveness.

The following liquids are recommended for use down to the limits indicated. None of these liquids is flammable.

Liquid	Percentage	Temperature limit
		°C.
Carbon tetrachloride		−23
Chloroform		−63
Carbon tetrachloride	49.4	−81
Chloroform	50.6	
Ethyl bromide		−119
Chloroform	19.7	−139
Ethyl bromide	44.9	
Trans-dichloroethylene	13.8	
Trichloroethylene	21.6	
Chloroform	14.5	−145 or −150
Methylene chloride	25.3	
Ethyl bromide	33.4	
Trans-dichloroethylene	10.4	
Trichloroethylene	16.4	
Chloroform	18.1	About −150
Ethyl chloride	8.0	
Ethyl bromide	41.3	
Trans-dichloroethylene	12.7	
Trichloroethylene	19.9	

SPECIFIC HEAT OF OILS

Physical and chemical tables and engineering handbooks give values for the specific heat of oils which vary within the limits 0.3 and 0.6—a variation of about 100 per cent. The customary practice has been to use the value 0.5 for all oils, irrespective of their nature. Existing data on the subject have lead to the rather general impression that the specific heat of petroleum oils varies over wide limits because of the great variation in the composition of oils from different fields.

The bureau was called upon recently to determine the specific heat of a number of oils in combination with other investigations being carried out in the laboratories of the Government. Specific heat determinations in temperature range 0 to 200° C. were made on 40 oils, consisting of 30 petroleum oils and 10 fatty oils. Other properties of these oils, such as density, viscosity, flash point, etc., which usually serve to specify or identify an oil, were also determined. The petroleum oils, obtained from many different fields, covered a wide range of density and viscosity. These oils are believed to be fairly representative of the commercial oils produced in this country.

The data obtained on this wide variety of oils in carrying out the tests requested by other laboratories have served this immediate purpose, but an analysis of all the data has resulted in certain general conclusions which are not very well recognized, although of considerable practical importance. For example, two of the conclusions which apply to both classes of oils, petroleum and fatty, are: (1) The increase in specific heat with

temperature is practically the same for all oils in the same class, the percentage increase being greater for petroleum oils than for fatty oils; and (2) the product of specific heat and density; that is, the heat capacity per unit volume, at a given temperature is practically constant for all oils of the same class, the constant being greater for fatty oils than for petroleum lubricating oils at room temperature. Thus it appears that the specific heat of an oil can now be predicted within narrow limits by placing a hydrometer in the oil and determining its density.

It was found that the specific heat of petroleum lubricating oils increased about 40 per cent between 0 and 200° C. The specific heat of different samples at 25° C. varied about 25 per cent, while the heat capacity per unit volume varied less than 5 per cent. Consistent differences in the latter quantity, amounting to about 2 per cent, were found between paraffin and naphthene base oils.

A critical review of the literature on the subject indicates that the general conclusions are substantiated by the results of other observers within the limits of experimental error and by such data as exist on pure substances which have been isolated as constituent parts of oils.

The results of this work are now being prepared for publication.

SAFETY CODE FOR AERONAUTICS IS PREPARED

An elaborate and comprehensive set of specifications for aircraft construction and rules for flying field maintenance and aircraft operation has been prepared under the sponsorship of the Bureau of Standards and the Society of Automotive Engineers with the object of rendering aviation more safe and reliable. This code represents the work of a committee of 33 engineers and officials in the aircraft industry, engineering and insurance circles, and in Government service, representing all organizations interested in assisting in the development of the code. Its preparation has extended over a period of four years and the draft was finally revised in April, 1925. It has now been printed and is being distributed by the Society of Automotive Engineers, 29 West Thirty-ninth Street, New York, at cost of publication—$1.50.

The code, issued as a tentative standard of the American Engineering Standards Committee, is divided into 10 parts and covers airplane design, assembly, and tests; airplane equipment, maintenance, and operation; signals and signaling equipment; airdromes and airways; traffic and pilotage rules; qualifications for airmen; free and captive balloons, airships; and parachutes.

KILOCYCLE-METER CONVERSION TABLE

There is increasing tendency in radio practice to use radiofrequencies in kilocycles rather than wave lengths in meters. "Kilo" means a thousand, and "cycle" means one complete alternation. The number of kilocycles (abbreviated kc) indicates the number of thousands of times that the rapidly alternating current in the antenna, transmitting set, or receiving set repeats its flow in either direction in one second.

The bureau has just issued in chart form a "Kilocycle-Meter Conversion Table." It is Miscellaneous Publication No. 67 and replaces Letter Circular No. 123 of January 27, 1925. The table is printed on a single sheet of cardboard and can be posted in a convenient place for ready reference. (Copies may be obtained for 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.)

The table gives accurate values of kilocycles corresponding to any number of meters, and vice versa. The table gives values for every 10 kilocycles or meters, and is entirely reversible; that is, for example, 50 kilocycles is 5,996 meters and also 50 meters is 5,996 kilocycles. The range of the table is from 10 to 10,000 kc (10,000 to 10 m) and this can be extended in either direction by changing the decimal point.

COMPARISON OF LAMPS FROM NATIONAL PHYSICAL LABORATORY

A group of specially constructed standard electric lamps from the National Physical Laboratory, Teddington

England, has been compared with a group of the bureau's primary carbon standards and a group of tungsten substandards. Three complete determinations, against carbon working standards, tungsten substandards, and carbon primary standards were made, seven observers making complete sets of readings. The results are very consistent and a very high precision was obtained in the tests. Values computed from the bureau's established characteristic curves show exceptionally good agreement. This international comparison is one of the most important tests made in the photometry section for some time.

STABILIZATION OF BUILDING CONSTRUCTION

One entire session of the meeting of the American Construction Council at Chicago on November 20 was devoted to stabilization of building. The influence of the investigation of the subject by the division of building and housing was evident throughout the proceedings, and several speakers who had made independent investigations of the percentage of direct winter expense to total construction cost confirmed the bureau's findings. One member of the Committee on Seasonal Operation in the Construction Industries wrote to the bureau as follows in regard to winter building: "The Department of Commerce has been of great assistance to the building industry in carrying this message with such cogency, speed, and wide distribution. I can hardly believe it possible that this was a new idea three years ago because it seems such an old and fully accepted principle of good business to-day. We have the committee and the Department of Commerce to thank."

HOME OWNERS' PROBLEMS

The division of building and housing assisted in the preparation of the guidebook for the 1926 Better Homes in America campaign which is to culminate in "Better Homes Week" April 25 to May 2. During the last campaign "Better Homes Week" was observed in more than 2,000 communities and there was a most encouraging increase in the number of demonstration houses which were built, furnished, and equipped at a cost within reach of the average income of the families in the community. Special emphasis is to be given in 1926 to the importance of keeping the cost of the demonstration house within the limits of a carefully prepared budget.

STEAM CLEANING A STONE BUILDING

To meet the changing demand of present-day commercial conditions many old buildings are being altered or remodeled. In order to eliminate the undesirable contrast always present in such cases between the old dirty surfaces and the new stone put in the walls some kind of cleaning of the old portions is generally carried out. Because of the detrimental effects of acid cleaning or sandblasting, scrubbing with soap powders and hand brushes is customarily employed. This method is effective but slow and laborious, and in an effort to devise a faster and more efficient means of cleaning limestone, experiments with the use of live steam have been conducted at the bureau under the cooperative research program undertaken by the bureau and the Indiana Limestone Quarrymen's Association, Bedford, Ind.

An interesting demonstration of this experimental work was the steam cleaning of the remodeled building of the Baltimore Commercial Bank, Baltimore, Md., where the scheme was given a practical trial under commercial conditions. The use of live steam at 80 pounds per square inch pressure blown directly against the stone through simple nozzles made of galvanized pipe fitted to the end of ½-inch steam hose lines was found to be very effective in removing the 20-year accumulation of dirt on this Indiana limestone building. Although the structure was heavily carved and molded, the work was done rapidly with inexperienced common labor, the engineer firing the boiler being the only skilled worker on the job. The cost of the job was somewhat higher than a bid received for acid cleaning. This increased cost is to be explained in part by the experimental character of the

work, this being the first complete building ever cleaned with steam. The final color of the stone was not so bright as that of new stone work, but was considered entirely satisfactory since it combined cleanliness with the appearance of age, which is usually thought desirable in stone buildings. The successful use of steam in this practical test leads to the conclusion that for the removal of dirt from old limestone buildings, the steam cleaning process would, in most cases, be an economical and effective method to employ, with the added advantage that it does not damage the stone.

REVISED PUBLICATION ON THE MANUFACTURE OF LIME

The bureau in 1913 issued its Technologic Paper No. 16, The Manufacture of Lime. This publication proved a most valuable contribution to the literature on the subject and consequently had wide distribution. However, many changes have occurred recently in the industry, and the necessity for a revision has long been felt. Therefore, during the year, to obtain the information desired, 12 lime plants, 1 ready-mixed mortar plant, and 1 limestone crushing plant were visited. At each locality an innovation in the lime industry was observed. The data collected are being used in the revision of the technologic paper, and includes information upon the following: (a) The production of chemical lime, (b) the latest type of gas-fired kilns, (c) new processes of hydration, (d) burning of lime in rotary kilns, (e) the operation of continuous draw kilns, (f) waste heat boilers located in shaft kilns, (g) automatic stokers as applied to shaft kilns, and (h) the procurement of limestone.

Furthermore, the field inquiry was conducted with the object of obtaining complete information about the process of lime manufacture.

It will probably be some time before the revised publication will be available at the office of the Superintendent of Documents, Government Printing Office, but when this paper is ready an announcement giving its price will be made in the Bulletin in the usual way.

CHANGE IN GRADING RULES FOR VITRIFIED SANITARY WARE

Important changes in the manufacture and grading rules of vitrified sanitary ware became effective on November 16 as the result of a conference of manufacturers and distributers with Government representatives at the Bureau of Standards. The grading rules do away with grades A and B, substituting the classifications "regular selection" and "culls." They also provide for accurate definitions which will facilitate the grading, so that the quality can be determined readily.

Representatives of 27 companies attended the conference. The discussion of the grading rules brought to light a sentiment that any run of kiln which fell below "regular selection" should be sold as "off grade" or scrapped. It was pointed out that each piece of ware put through the kilns costs the same to manufacture; and that the proposal would prevent any unscrupulous distributer from selling a grade B as a grade A, and leaving an impression in the mind of the purchaser that he was getting a grade A at a low price. It was further indicated that the proposed classification would be the same as that followed in grading porcelain ware. The change was adopted by each individual present.

The conference voted to recommend that the United States Government specifications for plumbing fixtures be held up pending the extension of the program and the completion of the regular procedure of the division of simplified practice. This will not be done until the dimensional standards for the industry are decided upon, as the result of a compilation from a questionnaire.

As a protection to the buyer, the meeting voted that each manufacturer will mark each crate in which "cull" ware is to be shipped with two splashes of red. These will be applied to the small end of such crates, so that the marks will be visible readily and will indicate to the distributer or to the user the grade he is getting.

As a further move toward elimination of waste in this industry, steps were

taken to survey the variety of items produced by each manufacturer, and the demand for each. This will serve as the basis for possible eliminations of obsolete varieties or of those seldom in demand, and will pave the way for a more compact list which will meet all needs.

Because the change of grading rules will involve a complete change of labels by all manufacturers, a subcommittee of manufacturers was appointed to consider a revision of the labels, comprising H. S. Maddock, of Thomas Maddock's Sons Co., Trenton, N. J.; George E. Hofman, of the Trenton Potteries Co.; and W. C. Chamberlin, of the Standard Sanitary Manufacturing Co., of Pittsburgh, Pa.

The conferees took immediate steps to notify all distribution centers of the changes in grading and in grading rules, and to cause the preparation of 100,000 copies of the new rules, which are to be put into the hands of the plumbing trade, architects, contractors, and others who have an immediate and direct interest in the action taken.

EFFECTS OF COMPOSITION ON PROPERTIES OF SHEET STEEL ENAMEL

A report of this work has been published in the current issue of the Journal of the American Ceramic Society, page 735. The report covers the results of an investigation of the properties of sheet steel enamels (white cover enamels) with respect to the effects produced by the substitution of feldspar for flint in one series and flint for feldspar in another series, together with variations in other constituents commonly used in enamels. Three series of enamels, differing from each other in the amounts of feldspar and flint introduced, and consisting of 20 enamels each, were prepared and applied to 8-inch steel dinner plates. Sixty different enamels were used.

The enameled plates were submitted to mechanical and thermal shock tests and to acid attack. The principal results obtained are as follows:

1. The coefficiency of expansion is one of the major factors affecting the ability of enamels to resist mechanical and thermal shock. The cubical coefficient of expansion of the 60 enamels studied ranged from 143×10^{-7} to 433×10^{-7}.

2. Resistance to thermal shock and to impact on parts of the ware free to deflect, increases with decreasing expansivity of the enamels.

3. Resistance to impact on a curved surface, or part of the ware not free to deflect, increases slightly with increasing expansivity. The basis for the last two statements is contained in the following condensed table of averages:

Averages of expansivity and results

Series	Average expansivity, cubical ($\times10^{-7}$)	Average numerical ratings		
		Thermal test	Impact on edge	Impact on center
I	345	77	197	313
II	297	99	182	373
III	220	136	181	364

4. Replacing the customary flint content of the enamels by feldspar increases the resistance to impact on edge and decreases resistance to quenching and acid attack.

5. Replacing the usual feldspar content of the enamels with flint greatly increases resistance to thermal shock and acid attack but decreases opacity.

6. Enamels containing both silica and feldspar in the usual commercial ratio were, on the whole, most satisfactory for general use, but enamels having certain excellent properties making them suitable for special purposes were developed in the other two series which contained, in one case, all flint in place of feldspar, and, in the other, all feldspar in place of flint.

SYNTHETIC TANNING MATERIALS

Further researches in connection with the evaluation of synthetic tanning materials have been conducted at the bureau in order to determine their hydrolytic action on hide substance. The results varied greatly with individual syntans, some showing a loss of hide substance as low as one-twentieth per cent in a solution having normal

acid concentration, as compared with others which showed practically complete destruction of the hide sample in half normal solutions. Six different syntans were examined in this manner, but the information obtained does not allow any definite classification as to those which will have either low or high hydrolytic action.

The rate of fixation of syntans by hide substance as well as the maximum amount fixed was also studied, and it was found that these properties were influenced greatly by the character of the syntan. The amount fixed by those syntans which were manufactured by first sulphonating an aromatic compound and then condensing with formaldehyde was less than for those in the manufacture of which the sulphonation and condensation were reversed. The rate of fixation for the former was greater, since the maximum combination took place in about a week and appeared to be independent of the concentration used, whereas the maximum fixation for the latter occurred in about three weeks.

From these results it appears that any syntan must be subjected to a thorough examination as to its destructive action on hide substance under the proposed conditions of use before it is safe for the tanner to use it in his process. It also appears that syntans produced by first sulphonating and then condensing are suitable for the tanning of light leathers only, and that high concentrations and long periods of treatment are not necessary. Heavier and firmer leathers can be produced with syntans in the manufacture of which the order of sulphonating and condensing have been reversed.

HEAT-RETAINING VALUE OF BLANKETS COVERED WITH SHEETING

The heat-retaining quality of blankets as affected by sheeting was studied at the bureau in connection with the investigation of the comforting value of blankets and other textile materials. Previous determinations have shown that the arrangement of the fibers in the material is probably the most important factor influencing the ability of the fabric to retain the heat. The question naturally arose as to how this could be influenced by placing a more closely woven material over the blanket. Cotton bed sheeting was selected for the experiments, since it is used to some extent for this purpose in households, and it was believed that results obtained would be comparable with other types of spreads and coverings.

The general character of the results obtained was uniform. One layer of sheeting appeared to add thermal resistance equal to about 10 per cent of the average blanket value. It should be pointed out that the experiments, following the usual test procedure, were carried out in still air of normal atmospheric condition. Hence they are applicable when blankets are used indoors. Moving air would no doubt influence these figures, but under such conditions the effect of the layer of sheeting should be even more favorable.

METHODS OF TESTING THE DEGREE OF SIZING OF PAPER

Most uses of paper require that it be sized so as to resist absorption of water, ink, and other aqueous solutions. Some uses require the degree of sizing to be within a definite small range, others require only a minimum value for good performance. The degree of sizing can be determined in a rough and ready manner without difficulty, but the more accurate measurement of this property of paper entails no little difficulty as evidenced by the fact that the attempt has given rise to more than 30 methods of measurement. All these methods are being listed, classified, and briefly described for the first time in a single publication which the bureau is preparing. This publication will also contain the detailed results of a comparative study of the most commonly used methods.

This study of the behavior of paper reveals the fact that the resistance to spreading on the surface, as is the case with ink lines, differs from the resistance to penetration through the sheet sufficiently to warrant regarding them as

separate properties of paper. Most of the test methods are designed to measure the penetration through the sheet, or the internal or body sizing of the paper. The outstanding feature of the various testing methods is the lack of agreement of their results. The chief cause of this disparity is neglect of one of the most characteristic properties of cellulose fibers. The fibers of paper selectively absorb materials from solution, so that most of the solutions used in the various tests act differently in this respect and measure not sizing alone, but sizing plus the particular absorptive propensity of each paper tested. In consequence the different methods classify paper in different orders.

The five outstanding methods compared were: (1) Ink flotation, (2) Okell electrolytic, (3) Stöckigt, (4) curl, and (5) a new indicator method. (Methods (4) and (5) were developed at the Bureau of Standards.) Over 60 samples of paper were tested by these methods in this comparative study. From these tests the following conclusions were drawn:

1. The most probable relative degree of internal sizing of the various samples tested is best represented by the data of the Bureau of Standards indicator method.

2. The agreement between the indicator method and the curl method is, in general, satisfactory.

3. The Stöckigt method is fairly dependable, but sometimes gives rather misleading results.

4. Selective absorption in the case of the ink-flotation test, and a resistivity error due to entrapped air in the case of the electrolytic method make these two methods very deceptive in testing well-sized papers.

SIMPLIFICATION OF WAREHOUSE FORMS

In September, 1924, the division of simplified practice called a conference of representatives of warehousemen, shippers, bankers, and others interested in the possible simplification of warehouse forms. This meeting was called at the request of the American Warehousemen's Association, which had appointed a committee to draft a set of warehouse forms to be presented for the consideration of all interests.

After a thorough discussion the conference approved the size and face of the forms and urged their general adoption. The standard terms and conditions to be printed on the reverse of certain forms were left for the further consideration of a future conference.

The forms met with such widespread approval that a bulletin has been prepared, known as Simplified Practice Recommendation No. 34, Warehouse Forms, which carries the formal indorsement of the Department of Commerce. This bulletin includes facsimiles of the forms themselves and a list of those who have accepted them in writing to the division of simplified practice. Copies of this bulletin can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents apiece.

PUBLICATIONS OF THE BUREAU OF STANDARDS ISSUED DURING NOVEMBER

Scientific Papers

S513. Origin of quenching cracks, Howard Scott. Price, 20 cents.

S514. Gases in metals. II. The determination of oxygen and hydrogen in metals by fusion in vacuum, Louis Jordan and James R. Eckman. Price, 10 cents.

Technologic Papers

T297. A statistical study of conditions affecting the distance range of radio telephone broadcasting stations, C. M. Jansky, jr. Price, 5 cents.

Miscellaneous Publications

M67. Kilocycle-meter conversion table. Price, 5 cents.

M69. Annual Report of Director of the Bureau of Standards for fiscal year ended June 30, 1925. Price, 5 cents.

OUTSIDE PUBLICATIONS

Methods of varying the sensitivity of galvanometers, F. Wenner, Journal of the Optical Society of America and Review of Scientific Instruments, Vol. II, No. 5, p. 495, November, 1925.

Production of negative and positive ions by electron collisions, F. L. Mohler, Physical Review, pp. 614–624, 1925.

The atom, Paul D. Foote, Scientific Monthly, pp. 449–452, 1925.

The determination of Uranium, G. E. F. Lundell and H. B. Knowles, Journal American Chemical Society, vol. 47, p. 2,637 (1925).

Lead filings and zinc dust as pipe jointing material, S. Rosenburg, Journal American Gas Association, p. 701, November, 1925.

Increasing the wear of sole leather, R. C. Bowker, Hide and Leather Magazine, October 31, 1925.

Bureau of Standards investigation of feldspar, R. F. Geller, The Ceramist, vol. 6, No. 6, p. 708, September, 1925.

Adhesion of gypsum plaster to concrete, anonymous, Cement, Mill and Quarry, p. 32, October 20, 1925.

Recent work of the lime, gypsum, and sand-lime brick section of the Bureau of Standards, anonymous, Rock Products, p. 60, October 31, 1925.

What the Bureau of Standards is doing for American industry, George K. Burgess, Industrial Management, Vol. LXX, No. 5, p. 257, November, 1925.

Work of the Bureau of Standards, George K. Burgess, the Military Engineer, Vol. XVII, No. 96, p. 455, November–December, 1925.

Uncle Sam—Practical Scientist, Hugh G. Boutell, Industry Illustrated, p. 12, November, 1925.

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